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DERWENT-WEEK: 200543

TITLE: Formation of **photocatalytic-function** film involves rotating substrate in vacuum chamber, and forming adhesive layer, titanium nitride aluminum nitride or **indium-tin oxide** film and titanium oxide film

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ABSTRACTED-PUB-NO: JP2003260371A

BASIC-ABSTRACT:

NOVELTY - A substrate (20) is rotated continuously in a vacuum chamber with different film-forming zones arranged at a sidewall. Plasma etching is performed in zone (I). An adhesive layer, titanium nitride, aluminum nitride or **indium-tin oxide** film, titanium oxide film and silica film are formed on the substrate in zones (II-V) respectively to obtain a multi-layered structure of **photocatalytic** function film.

DETAILED DESCRIPTION - A substrate (20) is rotated continuously in a vacuum chamber with different film-forming zones arranged at the sidewall of the chamber. Plasma etching is performed in zone (I). 5-20 nm of an adhesive layer such as titania and silica is formed on the substrate in zone (II). Titanium nitride which promotes crystallization of titanium oxide **photocatalytic** function, aluminum nitride film or **indium-tin oxide** film of 10-60 nm is formed in zone (III). Titanium oxide film is further crystallized on the substrate and a film of 100- 500 nm is formed in zone (IV). Silica film of 5-20 nm having super-hydrophilicity is formed on the substrate in zone (V) continuously within the chamber, to obtain a multi-layered structure of **photocatalytic** function film.

USE - Used for forming a **photocatalytic-function** film.

ADVANTAGE - A film with good **photocatalytic** function, adhesion, durability and improved crystallinity is obtained in a low temperature process.

DESCRIPTION OF DRAWING(S) - The figure shows a side view of the formation of a **photocatalytic-function** film with a multi-layered structure. (Drawing includes non-English language text).

Substrate 20

CHOSEN-DRAWING: Dwg.1/2

TITLE-TERMS: FORMATION **PHOTOCATALYST** FUNCTION FILM ROTATING SUBSTRATE VACUUM CHAMBER FORMING ADHESIVE LAYER TITANIUM NITRIDE ALUMINIUM NITRIDE **INDIUM TIN OXIDE** FILM TITANIUM OXIDE FILM

DERWENT-CLASS: D22 J04 M13

CPI-CODES: D09-B; J04-E; M13-F; N06;

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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] In the technique which forms the thin film which has a photocatalyst function on a substrate, especially adhesion of this invention is good, and it is related with the membrane formation approach of the photocatalyst functional film which can form membranes efficiently in a low-temperature process 100 degrees C or less.
[0002]
[Description of the Prior Art] The photocatalyst film which consists of a titanium dioxide (TiO2) as a catalyst which has from the former the function which disassembles an organic compound by light, such as sunlight, is known. And forming the film which consists of a silicon dioxide (SiO2) which has a hydrophilic property so that the fog resistance ability of a titanium dioxide may be maintained over long duration on a front face is known.
[0003] The approach that the film which has this photocatalyst function is established on a substrate with a spray coat or a binder (inorganic system binder) in the powder of a titanium dioxide, and the approach of covering the bilayer of the photocatalyst film of titanium oxide and the silicon dioxide film of a hydrophilic property with a sol-gel method on a substrate are used.
[0004] However, the inorganic system binder or the organic system binder was surely exposed to the surface part which demonstrates a photocatalyst function at a fixed rate, a photocatalyst function will be checked, and the approach with a binder etc. had a limitation in high performance-ization. Moreover, it is necessary to heat the liquid which the approach by the sol-gel method needed a lot of coating liquid for covering to homogeneity for the substrate of a large area, and was applied for considering as the film with strong abrasion resistance at high temperature (400 degrees C or more). For this reason, there was a limit of a base material and there was a problem also in respect of cost.
[0005] Then, membrane formation by the vacuum forming-membranes methods (the sputtering method, vacuum deposition, etc.) for excelling the above-mentioned spray coat or the binder, and the sol-gel method was able to be considered.
[0006]
[Problem(s) to be Solved by the Invention] However, in the sputtering method, although excelled in the point of covering the substrate of a large area, forming membranes, securing crystallization of the anatase structure of demonstrating a photocatalyst function with a titanium dioxide had the trouble of being difficult.
[0007] Especially the thing for which the photocatalyst film is stably formed efficiently at low temperature to a resin substrate etc. was difficult.
[0008] Then, this invention is TiO2 of anatase structure which was made in view of the above troubles and demonstrates a surprising photocatalyst function to adhesion especially on the front face of a resin substrate. Let it be a technical problem to offer the membrane formation approach of the photocatalyst film which can form a thin film efficiently in a low-temperature process 100 degrees C or less.
[0009]

[Means for Solving the Problem] Namely, this invention is set to claim 1, in order to solve the above technical problems. Plasma-etching processing is carried out in the 1st membrane formation zone, arranging and going around two or more membrane formation zones which are the membranous membrane formation approaches of having a photocatalyst function, and were established in the side attachment wall of a vacuum chamber continuously. next, the 2nd membrane formation zone -- this substrate top -- TiO2 and SiO2 5-20nm of glue lines is formed. etc. -- Next, it is TiOn on a substrate in the 3rd membrane formation zone. TiN which promotes crystallization of a photocatalyst function, TiOn which formed the AlN film or 10-60nm of ITO film, and was further crystallized on the substrate in the 4th membrane formation zone 100-500nm of film is formed. SiO2 of the super-hydrophilic property [top / substrate] in the 5th membrane formation zone furthermore It is characterized by performing continuously membrane formation of the multilayer structure which formed 5-20nm of film within one chamber.

[0010]

[Function] namely, the substrate top which moves while performing sputtering by the target and going in the 2nd membrane-formation zone where the electric power supply was changed around continuously, after plasma-etching processing is performed in the 1st membrane-formation zone by which was prepared in the side attachment wall of a vacuum chamber, and the electric power supply was carried out to the substrate which moves while this invention goes around continuously within a vacuum chamber -- TiO2 and SiO2 etc. -- 5-20nm of glue lines by which the laminating was carried out forms. Then, an electric power supply is changed and it is TiOn by reactive sputtering of the 3rd membrane formation zone. 10-60nm is formed on the substrate which moves while going around TiN which promotes crystallization of the photocatalyst functional film, the AlN film, and the ITO film.

[0011] Then, TiOn which changed the supply voltage further and was crystallized by reactive sputtering of the 4th membrane formation zone 100-500nm forms membranes on the substrate which moves the film. And a supply voltage is changed going a substrate around further and moving, and it is SiO2 of a super-hydrophilic property by reactive sputtering of the 5th membrane formation zone. When 5-20nm forms membranes on the substrate which moves the film, the film which has the photocatalyst function of multilayer structure can be formed continuously.

[0012] Thus, the film which has the photocatalyst function of the multilayer structure which continued on the substrate within one chamber can be formed at low temperature.

[0013] moreover, a substrate -- plasma-etching processing, TiO2, and SiO2 etc. -- while preparing a glue line, the adhesion to the substrate of the photocatalyst film will be more excellent by preparing TiN which promotes crystallization of the photocatalyst functional film, the AlN film, and the ITO film.

[0014] Furthermore, TiO2 crystallized in the anatase structure of demonstrating a photocatalyst function on the above-mentioned glue line A thin film can be efficiently formed in a low-temperature process 100 degrees C or less.

[0015]

[Embodiment of the Invention] One example of the membrane formation approach of the photocatalyst film of this invention is explained along with a drawing. In explanation, drawing 1 (b) and (b) are the approximate account side elevations showing the membrane formation of multilayer structure which has the photocatalyst function of the multilayer structure formed with the membrane formation equipment of this invention, and drawing 2 is the approximate account top view showing one example of the membrane formation equipment of this invention.

[0016] The membrane formation equipment 1 of this invention consists of the 1st membrane formation equipment 3 prepared in the lengthwise direction of the side attachment wall of the vacuum chamber 2, the 2nd membrane formation equipment 4, the 3rd membrane formation equipment 5, and the 4th membrane formation equipment 6. In addition, the number of membrane formation equipment can be changed free according to the laminating conditions to a substrate.

[0017] It can form Ti film, SiO2 film, or the ITO film by the spatter, for example while RF power source which impresses power to the target and this target of a pair by turns, and MF power source can constitute said 1st membrane formation equipment 3 possible [a change] through a switch, it can

change plasma-etching processing and a spatter by this and performs plasma-etching processing to a substrate 20.

[0018] Said 2nd membrane formation equipment 4, the 3rd membrane formation equipment 5, and the 4th membrane formation equipment 6 consist of reactant sputtering systems. For example, it is the configuration that gas installation tubing for introducing reactant gas (Ar+O2 or Ar+N2) was formed between the targets of a pair, or in near.

[0019] Next, the membrane formation equipment 1 for the photocatalysts of the above-mentioned example is used, and the case where membranes are formed on the stainless steel substrate 20 (when forming membranes to the 1st example stainless steel substrate) is explained.

[0020] In first, the location which moves going a substrate 20 around continuously within the vacuum chamber 2, and counters the 1st membrane formation equipment 3 (Ti target) The 1st membrane formation equipment 3 performs plasma-etching processing by RF power application, a switch is changed after that, MF power is supplied, and it is argon Ar+O2. Reactant gas is supplied. Sputtering by Ti target is performed and it is TiO2 on a substrate 20. A membranous glue line is formed 20nm of thickness.

[0021] Then, a substrate 20 is moved further, going around continuously, and it is reactant gas Ar+N2. By performing sputtering by Ti target with the 2nd membrane formation equipment 4 (Ti target) with which the supply voltage was switched while introducing, it is TiO2 on the above-mentioned substrate 20. The TiN film which promotes crystallization of the becoming photocatalyst functional film is formed 30nm of thickness. This becomes possible to make adhesion to the substrate of the photocatalyst film more reliable.

[0022] Then, a substrate 20 is moved further, going around continuously, and it is reactant gas Ar+O2. TiO2 further crystallized on the above-mentioned substrate 20 by performing sputtering by Ti target with the 3rd membrane formation equipment 5 (Ti target) with which the supply voltage was switched while introducing The film is formed 300nm of thickness. Namely, TiO2 of anatase structure which demonstrates a photocatalyst function A thin film can be efficiently formed in a low-temperature process 100 degrees C or less.

[0023] And a substrate 20 is moved further, going around continuously, and it is reactant gas Ar+O2. SiO2 of a super-hydrophilic property which heightens the photocatalyst effectiveness as a top layer on the above-mentioned substrate 20 by performing sputtering by Si target with the 4th membrane formation equipment 6 with which the supply voltage was switched while introducing The film can be formed 10nm of thickness.

[0024] It enables this to form continuously the film which has the photocatalyst function of multilayer structure (TiO2, the TiN film, TiO2 film, and SiO2 film) within one chamber to the stainless steel substrate 20.

[0025] Next, the membrane formation equipment 1 for the photocatalysts of the above-mentioned example is used, and the case where membranes are formed on a plastic plate 20 (the 2nd example) is explained.

[0026] The 1st membrane formation equipment 3 (Si target) by which the supply voltage was moved and carried out performs plasma-etching processing by RF power application first like the above, going a substrate 20 around continuously within the vacuum chamber 2, MF power is impressed by the change of a switch after that, and it is reactant gas Ar+O2. While introducing, sputtering by Si target is performed, and it is SiO2 on a substrate 20. A membranous glue line is formed by 20nm of thickness.

[0027] Then, a substrate 20 is moved further, going around continuously, and it is reactant gas Ar+N2. While introducing, the AlN film which performs sputtering by aluminum target with the 2nd membrane formation equipment 4 (aluminum target) with which the supply voltage was switched, and promotes crystallization of the photocatalyst functional film of SiO2 on the above-mentioned substrate 20 is formed 30nm of thickness.

[0028] Then, a substrate 20 is moved going around continuously further, and it is reactant gas Ar+O2. TiO2 further crystallized on the above-mentioned substrate 20 by performing sputtering by Ti target with the 3rd membrane formation equipment 5 (Ti target) with which the supply voltage was switched

while introducing The film is formed 300nm of thickness.
[0029] And a substrate 20 is moved going around continuously further, and it is reactant gas Ar+O2. SiO2 of a super-hydrophilic property which heightens the photocatalyst effectiveness as a top layer on the above-mentioned substrate 20 by performing sputtering by Si target in the 4th membrane formation zone 6 (Si target) where the supply voltage was switched while introducing The film is formed 10nm of thickness.
[0030] It enables this to form continuously the film which has the photocatalyst function of multilayer structure (SiO2 [Film] the film, the AlN film, and TiO2 the film and SiO2) within one chamber to a plastic plate 20.
[0031] Thus, according to the class of substrate, to a substrate, adhesion is good and can form the high film of a photocatalyst function continuously at low temperature with various combination.
[0032]
[Effect of the Invention] thus, by realizing processing of a low-temperature process within the continuous vacuum chamber, the membranous membrane formation approach of having the photocatalyst function of this invention is forming membranes into the substrate ingredient with which the resin substrate, the textile base material, etc. were made conventionally impossible, and has the advantage that the application is markedly alike and spreads.
[0033] moreover, it is effective in adhesion force and crystallinity improving, consequently endurance and a photocatalyst function being markedly alike and improving compared with what was formed in the conventional low-temperature process.

[Translation done.]